

Swift Observations of GRB 100305A

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1 Introduction

The Swift/BAT triggered and located GRB 100305A (Trigger 414905) at 09:05:38 UT (Troja, *et al.*, *GCN Circ.* 10470). This was an image trigger on a burst with $T_{90} = 69.7$ sec. Swift slewed immediately to the burst, XRT and UVOT began follow-up observations at $T + 139.3$ sec and $T + 144$ sec respectively.

Our best position is the XRT enhanced position (Osborne, *et al.*, *GCN Circ.* 10474): RA($J2000$) = 168.36691 deg ($11h13m28.06s$), Dec($J2000$) = $+42.40393$ deg ($42d24'14.1''$) with an uncertainty of 1.7 arcsec (radius, 90% confidence).

A faint optical afterglow was identified by Gemini-N observations (Cucchiara, *et al.*, *GCN Circ.* 10473, *GCN Circ.* 10478).

2 BAT Observation and Analysis

Using the data set from $T - 239$ to $T + 963$ sec, further analysis of BAT GRB 100305A has been performed by the Swift team (Krimm, *et al.*, *GCN Circ.* 10479). The BAT ground-calculated position is RA($J2000$) = 168.373 deg ($11h13m29.5s$), Dec($J2000$) = 42.381 deg ($42d22'50.7''$) with an uncertainty of 1.9 arcmin (radius, sys+stat, 90% containment). The partial coding was 22%.

The mask-weighted light curve (Fig. 1) shows a broad structure of two overlapping peaks beginning at $T + 0$ sec and continuing to $T + 80$ sec with the highest peak at $T + 60$ sec. There is soft, low-level emission extending to $\sim T + 200$ sec. T_{90} (15-350 keV) is 69.7 ± 8.7 sec (estimated error including systematics).

The time-averaged spectrum from $T - 9.2$ to $T + 70.3$ sec is best fit by a simple power-law model. The power law index of the time-averaged spectrum is 1.27 ± 0.23 . The fluence in the 15-150 keV band is $(1.5 \pm 0.2) \times 10^{-6}$ ergs/cm². The 1-sec peak photon flux measured from $T + 62.72$ sec in the 15-150 keV band is 0.9 ± 0.3 ph/cm²/sec. All the quoted errors are at the 90% confidence level.

3 XRT Observations and Analysis

The Swift/XRT began follow-up observations of the field of GRB 100305A 139.3 sec after the BAT trigger (Troja, *et al.*, *GCN Circ.* 10470). The dataset consists of 8 s of Windowed Timing (WT) settling mode, 74 s of WT mode, and 69 ks of Photon Counting (PC) mode observations.

Using 2448 sec of XRT PC mode data and 6 UVOT images for GRB 100305A, we find an astrometrically corrected X-ray position (using the XRT-UVOT alignment and matching UVOT field sources to the USNO-B1 catalogue): RA($J2000$) = 168.36691 deg ($11h13m28.06s$), Dec($J2000$) = $+42.40393$ deg ($42d24'14.1''$) with an uncertainty of 1.7 arcsec (radius, 90% confidence; Osborne, *et al.*, *GCN Circ.* 10474). This position lies 4.5 arcsec from the optical afterglow (Cucchiara, *et al.*, *GCN Circ.* 10473).

The 0.3-10 keV light curve (Fig. 2) shows an initial steep power-law decay with an index of $\alpha=5.1 \pm 0.5$. After the first orbit, the lightcurve flattens to an index of 0.70 ± 0.10 and breaks at $T + 13500$ sec to a steeper decay index of 2.14 ± 0.17 .

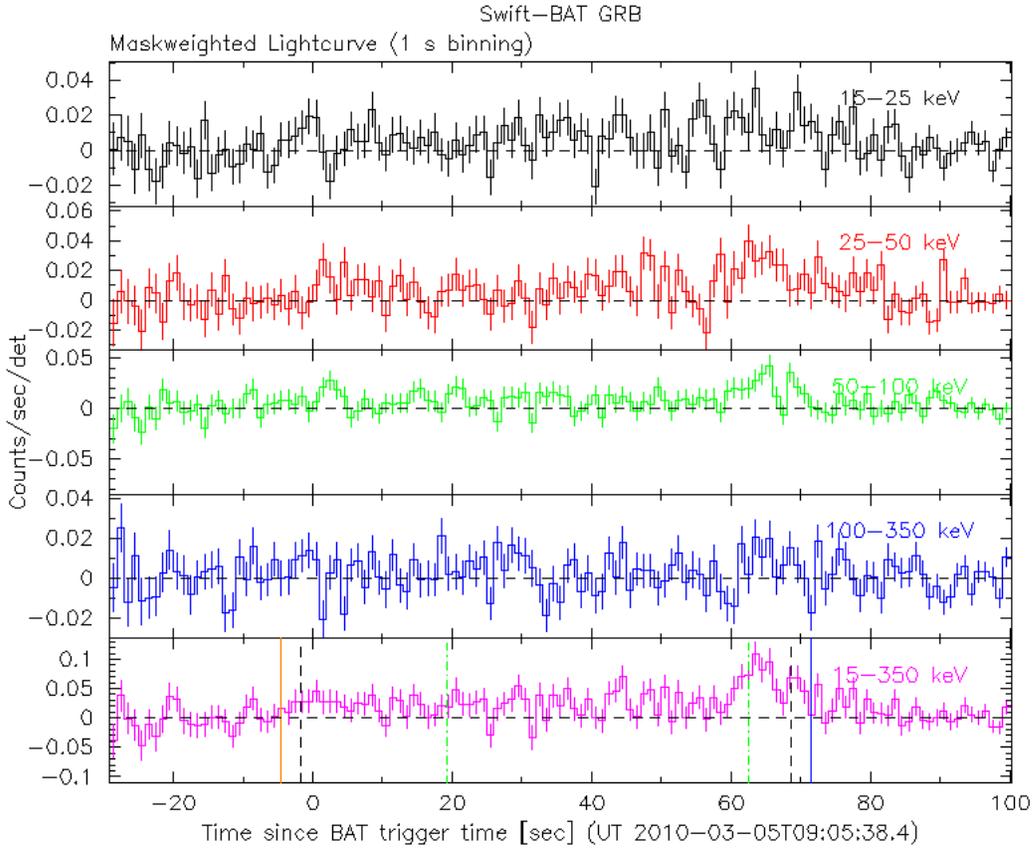


Figure 1: BAT Light curve. The mask-weighted light curve in the 4 individual plus total energy bands. The units are counts/sec/illuminated-detector.

A spectrum formed from the WT mode data can be fit with an absorbed power-law with a photon index of $1.96^{+0.21}_{-0.20}$ and a column density $N_H = (1.7 \pm 0.5) \times 10^{21} \text{ cm}^{-2}$, in excess of the Galactic value of $2.1 \times 10^{20} \text{ cm}^{-2}$ (Kalberla et al. 2005). The PC mode spectrum has a photon index of $2.14^{+0.24}_{-0.20}$ and a column density of $1.7^{+0.6}_{-0.3} \times 10^{21} \text{ cm}^{-2}$. The approximate counts to observed (unabsorbed) flux conversion factor is $1 \text{ count/sec} = 3.8 \times 10^{-11} \text{ (} 5.8 \times 10^{-11} \text{) ergs/cm}^2\text{/sec}$.

4 UVOT Observation and Analysis

The Swift/UVOT began settled observations of the field of GRB 100305A 144s after the BAT trigger (Siegel, *et al.*, *GCN Circ.* 10477). Data summed from the first and second orbits do not reveal a source at the enhanced position of the X-ray afterglow (Osborne, *et al.*, *GCN Circ.* 10474) or at the position of the optical afterglow (Cucchiara, *et al.*, *GCN Circ.* 10473). UVOT 3σ upper limits for this field are reported in Table 1.

The quoted upper limits have not been corrected for the expected Galactic extinction along the line of sight, corresponding to a reddening of $E_{B-V} = 0.01 \text{ mag}$ (Schlegel et al. 1998, *ApJ*, 500, 525). All photometry is on the UVOT photometric system described in Poole et al. (2008, *MNRAS*, 383, 627).

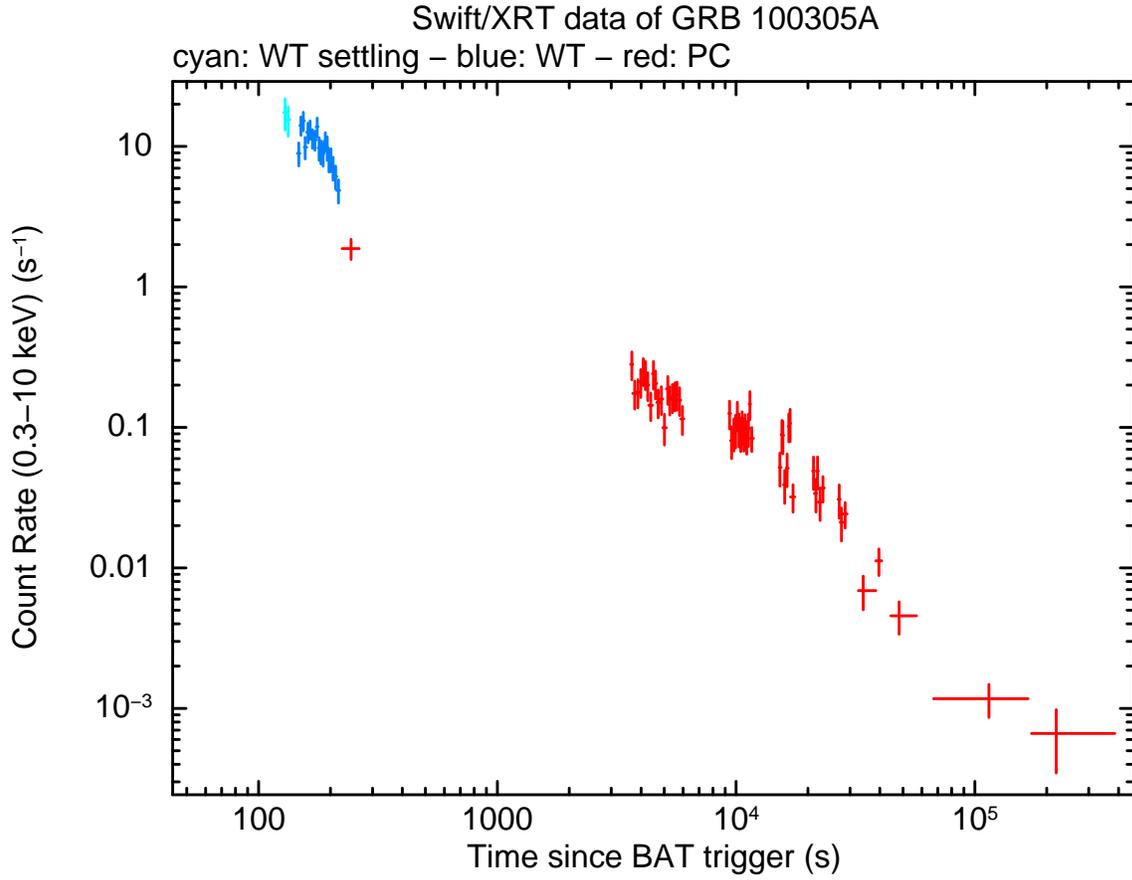


Figure 2: XRT light curve. Counts/sec in the 0.3-10 keV band: Windowed Timing settling mode (cyan), Windowed Timing mode (blue), Photon Counting mode (red). The approximate counts to observed (unabsorbed) flux conversion factor is 1 count/sec = 3.8×10^{-11} (5.8×10^{-11}) *ergs/cm²/sec*.

Filter	Start	Stop	Exposure	3σ UL
white (FC)	144	266	120	> 20.60
white	4636	4836	196	> 21.10
v	3612	5247	393	> 19.85
b	4432	6048	373	> 20.68
u	4227	5863	393	> 20.45
uvw1	4022	5656	393	> 20.46
uvm2	3817	5451	393	> 20.2
uvw2	4842	5042	196	> 20.17

Table 1: Magnitude limits from UVOT observations